Options Considered Document

ECE 403: Senior Design II

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Introduction:

The hybrid-formula vehicle competition will take in Loudon, New Hampshire, USA, from April 20 – May 1, 2014. The Clean Snowmobile Challenge will take place in Houghton, Michigan, USA, March 3 – 8, 2014. This project is in collaboration with the Society of Automotive Engineers (SAE) NDSU chapter and the main focus of these projects will be relative to the electrical systems of both vehicles.

Previous Work:

The hybrid formula and clean snowmobile project for the 2014 competition will not be NDSU's first attempt at the competitions. It will be the second time for NDSU to compete in the formula hybrid competition, as this competition is fairly new. The clean snowmobile challenge will also not be NDSU's first attempt either. Both of the NDSU SAE teams will be competing with brand new chassis and motor designs since updates in the designs happen regularly.

2011 Hybrid formula car on old chassis

2012 Clean Snowmobile Challenge with diesel motor

Design Options:

Since our group won't be designing a product like most ECE senior design groups, our design options are mostly unknown to us until we find a problem and brainstorm ideas between our ECE group and the SAE teams. However, a few known problems exist, but to what extent they are remains in the dark until both groups spend a good amount of time reading up on the previous senior design groups work. The known problems are the following: wiring harness in disarray, IC engine controller or other IC engine electronics are possibly fried from overvoltage, clean snowmobile engine has a melted piston and leaks oil, and clean snowmobile design has issues with charging the battery and holding a charge.

New Wiring Harness:

Since the formula hybrid car from 2011 was dismantled and migrated to the new chassis, the wiring harness linking the battery management system, AC motor and its controller, and the IC engine controller has been unplugged in various areas and plugged into other areas. This provides a tough challenge since the wires a not marked and little

documentation is provided. Therefore, one idea is to completely rebuild the wiring harness from the ground up.

Advantages:

- Provides a working wiring harness after completion
- Documentation can be created
- Team members will know how everything is connected

Disadvantages:

- Time consuming
- Requires new wires to be made
- Not very easy

Rebuild Old Wiring Harness:

This option may be the better of the two, because it takes into account replacing old parts with new wires. There should be sections of the harness that shouldn't need any replacing, if found that the particular section is connected up correctly.

Advantages:

- Less time consuming
- Easier to get finished if few problems exist

Disadvantages:

- Requires time to go through the old wiring harness and check for errors
- Can be tedious and frustrating since wires are unmarked

IC Engine Electronics and Controller:

Since this particular problem is dependent on getting wiring harness figured out and working correctly, very few options exist at the moment. It is believed that the IC engines electronics were fried due to the 72 volt wiring harness being connected to it. This was most likely due to having the electrical components moved from the old car to the new one.

Replace Faulty Components:

Our team and the SAE team will troubleshoot and replace faulty components as they become apparent.

Advantages:

- Cost can be kept to a minimum if few or none of the components are faulty
- Not terribly hard to check for problems with components

Disadvantages:

- Can be time consuming if other problems are found
- Parts may not be obtainable
- Cost may be high for parts

Components Work as Intended:

This option would be the best option since no new parts would need to be ordered and time would be kept to a minimum.

Advantages:

- Has the best time benefit if all the components work
- Doesn't require money to buy new parts
- Less work for both teams

Disadvantages:

- Least likely to happen
- Difficult to detect if parts are partially working or work intermittently

Clean Snowmobile Challenge:

When the Clean Snowmobile Challenge team competed last year, a major oil leak was found 20-30 miles into the course that ended the team's progress. When the machine was brought back to the shop and torn down, it was discovered that oil had leaked out of the crankcase and into the chassis. When the motor was taken apart, one of the pistons had melted and pooled in the bottom of the crankcase, thus ending that engines service life. As for the electrical side, there is an issue with the charging system not charging the battery and dying when sitting for a short periods of time.

Our main focus on this project will be with the faulty charging system of the snowmobile.

Replace Faulty Electrical System:

Replace the existing charging system with new heavy duty components to handle the increase in current required to start the diesel engine and charge the battery.

Advantages:

- Can handle greater current loads
- Faulty wiring and components are removed to prevent future problems
- Should work upon completion

Disadvantages:

- Moderately expensive
- Time consuming to design, build, and implement into existing wiring harness.

Use Existing System:

This option may be the simplest and cheapest to implement. A hybrid of new components and existing components would probably provide the greatest benefit in terms of cost and time consumed.

Advantages:

- Cheap
- Less time involved
- Quicker recovery time to get the machine going again.

Disadvantage:

May encounter unforeseen electrical problems